Artificial Neural Networks

4th Assignment - Shahid Beheshti University - Bachelor's Program

December 15, 2022

I hope all is well with you. This is the fourth series of homework for the Artificial Neural Networks course. The deadline for this assignment is **due date December 25, Sunday**. All students are expected to submit their homework on time. Feel free to **ask questions regarding the exercises in the course Telegram group** if needed. As part of your assignment, you are required to write a detailed report.

Exercise 1

How does the VAE architecture allow it to generate new data points, especially compared to associative auto-encoder, which cannot generate new data points?

Exercise 2

Variational auto-encoders optimize a lower bound of the data likelihood for a given input sample $x^{(i)}$ such that

$$\mathcal{L}(\theta, \phi; x^{(i)}) = \mathbb{E}_{q_\phi(z|x^{(i)})}[log\, p_\theta(x^{(i)}|z)] - D_{KL}(q_\phi(z|x^{(i)})||p_\theta(z)).$$

- Explain the task of the KL−divergence term.
- Write down the advantage of modeling $p_\theta(z)$ and $q_\phi(z|x^{(i)})$ by using Normal distribution with a diagonal covariance matrix.
- Explain the task of the first term and its effect on the latent space.

Exercise 3

Take 1000 images from CIFAR10. Then, given a pair of images from CIFAR10 x_1 and x_2, build a network that can return both images given their average $\frac{x_1+x_2}{2}$ as the only input. The design of the architecture and of the input-output mapping is your choice.

- An extra mark will be awarded to the student who achieves the lowest loss on the test data in the class (+20 pts).